



PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
 United States Patent and Trademark  
 Office  
 Box PCT  
 Washington, D.C. 20231  
 ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 15 October 1999 (15.10.99)	
<b>International application No.</b> PCT/US99/07729	<b>Applicant's or agent's file reference</b> BKS 308 P2-P
<b>International filing date</b> (day/month/year) 08 April 1999 (08.04.99)	<b>Priority date</b> (day/month/year) 08 April 1998 (08.04.98)
<b>Applicant</b> EGAN, John, J., III et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

09 September 1999 (09.09.99)

☐ in a notice effecting later election filed with the International Bureau on:
2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
 34, chemin des Colombettes  
 1211 Geneva 20, Switzerland

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Authorized officer

A. Karkachi

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# PATENT COOPERATION TREATY

## PCT

6

REC'D 10 MAY 2000

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### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>BKS 308 P2-P</b>	<div style="display: flex; justify-content: space-between;"> <div>FOR FURTHER ACTION</div> <div>See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)</div> </div>	
International application No. <b>PCT/US99/07729</b>	International filing date (day/month/year) <b>08 APRIL 1999</b>	Priority date (day/month/year) <b>08 APRIL 1998</b>
International Patent Classification (IPC) or national classification and IPC Please See Supplemental Sheet.		
Applicant <b>THERMO BLACK CLAWSON INC.</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets.  
☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
 These annexes consist of a total of 7 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand <b>09 SEPTEMBER 1999</b>	Date of completion of this report <b>27 APRIL 2000</b>
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer <b>CLAYTON E. LABAYLE</b> Telephone No. (703) 308-1482

**I. Basis of the report****1. With regard to the elements of the international application:\***☐ the international application as originally filed☒ the description:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

☒ the claims:

pages (See Attached)

, as originally filed

pages , as amended (together with any statement) under Article 19

pages , filed with the demand

pages , filed with the letter of

☒ the drawings:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

☒ the sequence listing part of the description:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:**☐ contained in the international application in printed form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.**4. ☒ The amendments have resulted in the cancellation of:**☒ the description, pages none☒ the claims, Nos. 34-38☒ the drawings, sheets/fig none**5. ☒ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\*Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. statement**

Novelty (N)	Claims <u>2-3, 5-27, 29-33</u>	YES
	Claims <u>1, 4, 28</u>	NO
Inventive Step (IS)	Claims <u>24-27</u>	YES
	Claims <u>1-23, 28-33</u>	NO
Industrial Applicability (IA)	Claims <u>1-38</u>	YES
	Claims <u>none</u>	NO

**2. citations and explanations (Rule 70.7)**

Claim 1 lacks novelty under PCT Article 33(2) as being anticipated by Bozeman. Bozeman discloses an apparatus which performs a method of processing a material. The apparatus has a stationary member (80) and a submersible rotatable member (50) which is within the stationary member and acts on the material in which it is submerged. The rotatable member is partially supported by magnetic bearings. The bearings control the axial and radial position of the rotatable member by maintaining the rotatable member in the proper position relative to the stator. Applicant's claims do not set forth that the position of the rotatable member is actively controlled or adjusted.

Claims 4 and 28 lack novelty under PCT Article 33(2) as being anticipated by Dosch. Dosch discloses a paper pulp processing unit with a stationary member (14), a rotatable drive member (28) and a rotatable pulp processing component (34, 36 or 44). The bearings control the axial and radial position of the rotatable member by maintaining the rotatable member in the proper position relative to the stator. Applicant's claims do not set forth that the position of the rotatable member is actively controlled or adjusted.

Claims 2-3, 5, 7, 13 and 29-32 lack an inventive step under PCT Article 33(3) as being obvious over Bozeman in view of Dosch and Giardini. Bozeman discloses the apparatus essentially as claimed except for the motor being a switched reluctance motor and using the apparatus as a paper pulp processing machine. Dosch teaches that it is well known to utilize a submersible rotatable member as a paper pulp processing machine. It would have been obvious to have utilized the machine of Bozeman with a submersible rotatable member as a paper processing machine, as shown by Dosch. Giardini teaches that it is well known to utilize a variable reluctance motor to drive the rotatable member of a submersible material processing apparatus. Giardini further teaches that it is well known to control the input to the motor (switching) to control the motor. One advantage to utilizing a reluctance motor is that the motor does not require permanent magnets to operate and the rotor can be made durable and with a simple shape. It (Continued on Supplemental Sheet.)

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

**CLASSIFICATION:**

The International Patent Classification (IPC) and/or the National classification are as listed below:

IPC(6): H02K 5/132, 7/09, 7/14; B01D 33/56; F04B 17/04; B02C 7/02, 7/06, 7/14, 7/16 and US Cl.: 310/67R, 87, 90.5; 210/380.3 417/355, 423.7; 241/259.1

**I. BASIS OF REPORT:**

This report has been drawn on the basis of the description,  
page(s) 1-14, as originally filed.  
page(s) NONE, filed with the demand.  
and additional amendments:  
NONE

This report has been drawn on the basis of the claims,  
page(s) NONE, as originally filed.  
page(s) NONE, as amended under Article 19.  
page(s) NONE, filed with the demand.  
and additional amendments:  
Pages 15-21, filed with the letter of 17 December 1999.

This report has been drawn on the basis of the drawings,  
page(s) 1-4, as originally filed.  
page(s) NONE, filed with the demand.  
and additional amendments:  
NONE

This report has been drawn on the basis of the sequence listing part of the description:  
page(s) NONE, as originally filed.  
pages(s) NONE, filed with the demand.  
and additional amendments:  
NONE

5. (Some) amendments are considered to go beyond the disclosure as filed:  
none

**V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):**

would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized a switched reluctance motor in the apparatus of Bozeman, and Bozeman in view of Dosch, in order to take advantage of the durable characteristics of that type of motor, as shown by Giardini.

Claims 8-9 and 33 lack an inventive step under PCT Article 33(3) as being obvious over the prior art as applied in the immediately preceding paragraph and further in view of Chancellor. Bozeman, Dosch and Giardini disclose the apparatus essentially as claimed except for providing a hollow shaft. Chancellor teaches that it is well known to utilize a hollow shaft in a motor in order to provide an inlet and passage of the material to the component acting on the material. As can be seen in Chancellor, this eliminates the need for additional elements to couple the motor rotor to the shaft, thereby simplifying the assembly.

Claims 10-12 lack an inventive step under PCT Article 33(3) as being obvious over the prior art as applied in the immediately preceding paragraph and further in view of Xiangzhi and Croopnick. The previous references disclose the apparatus essentially as claimed except for utilizing a disk refiner or a screen cylinder. Xiangzhi teaches that it is well known to utilize a disk refiner driven by a motor as a pulp processing apparatus. Croopnick teaches the use of a screen cylinder to perform a process on paper pulp. The use of these items as paper pulp processing components in the assembly of Bozeman, Dosch, Giardini and Chancellor would not involve an inventive step.

Claim 6 lacks an inventive step under PCT Article 33(3) as being obvious over Bozeman in view of Dosch and further in view

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 11

of Croopnick. Bozeman and Dosch disclose the apparatus essentially as claimed except for the rotatable pulp processing component being a screen cylinder. Croopnick teaches that the use of a screen cylinder (9) as a rotatable pulp processing component would not involve an inventive step.

Claims 14-15 lack an inventive step under PCT Article 33(3) as being obvious over Bozeman in view of Dosch and further in view of Bramm. Bozeman and Dosch disclose the apparatus essentially as claimed except for providing a second set of magnetic bearings to control the axial position of the rotor and an inclined surface on the rotor and the stator. Bramm teaches it is well known in an apparatus to have a second set of magnetic bearings to control the axial position of the rotor and to provide inclined surfaces on the rotor and the stator at which the magnetic bearings are located so that the bearings control the axial and radial position of the rotor. The use of such arrangements in the assembly of Bozeman and Dosch would not involve an inventive step.

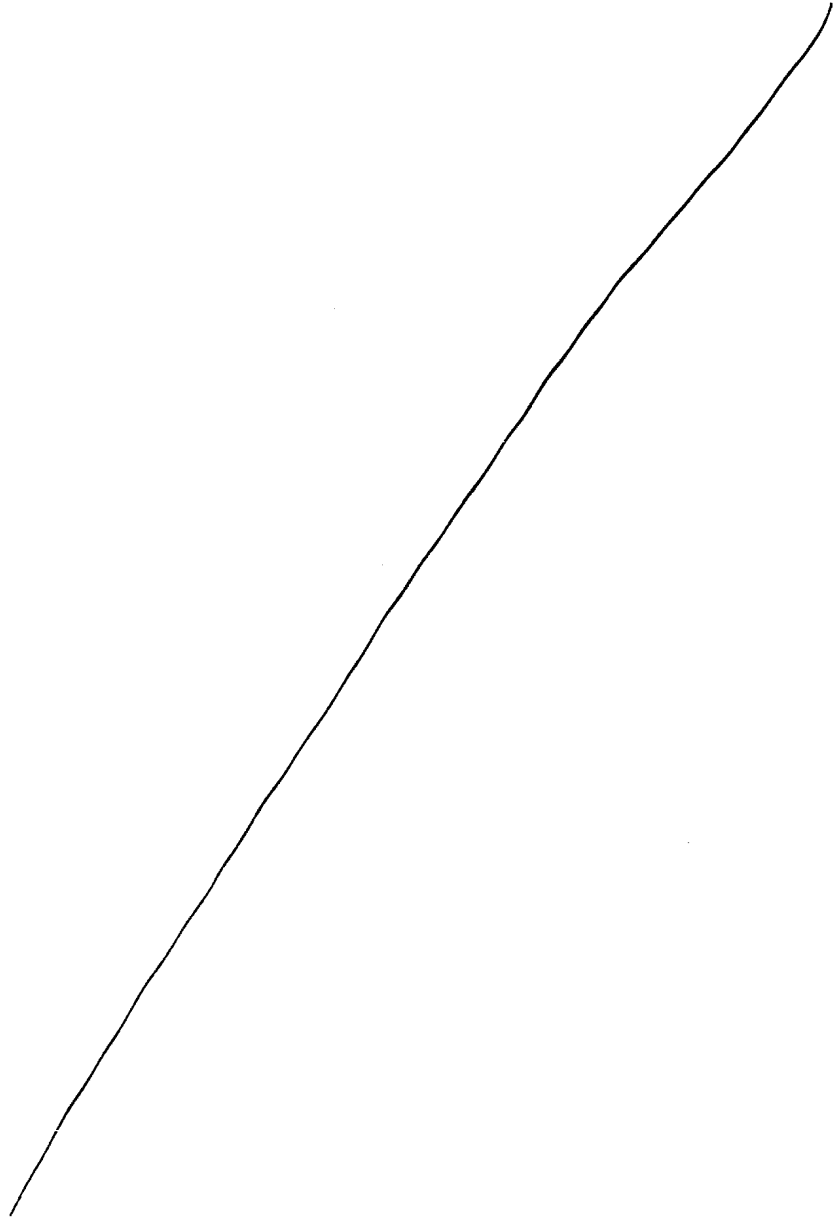
Claims 16-20 and 22-23 lack an inventive step under PCT Article 33(3) as being obvious over Bramm in view of Xiangzhi. Bramm discloses a motor driven apparatus with a submersible rotor which drives a component to act on a material. Xiangzhi discloses the use of a disk refiner which is driven by a motor to process pulp. The combination of a motor with an integral submersible member and a motor driven disk refiner to produce a disk refiner which is driven by an integral motor would not involve an inventive step. Integrating the motor into the disk refiner produces a more compact assembly.

Claim 21 lacks an inventive step under PCT Article 33(3) as being obvious over the prior art as applied in the immediately preceding paragraph and further in view of Chancellor. Bramm and Xiangzhi disclose the apparatus essentially as claimed except for providing a hollow shaft. Chancellor teaches that it is well known to utilize a hollow shaft in a motor in order to provide an inlet and passage of the material to the component acting on the material. As can be seen in Chancellor, this eliminates the need for additional elements to couple the motor rotor to the shaft, thereby simplifying the assembly.

Claims 24-27 the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a screen for screening a flow of papermaker's stock with a switched reluctance motor with a screen adjacent the stator and a fluid foil carried by the rotor. Further, the prior art fails to teach or suggest the screen claimed with magnetic bearings supporting the rotor.

----- NEW CITATIONS -----

-21-



REPLACED BY  
ART 34 AMDT

-15-

--CLAIMS--

1. Apparatus comprising a motor having a stationary member and a submersible rotatable drive member, and bearing means for supporting said rotatable drive member.
2. Apparatus as recited in claim 1 further comprising a submersible rotatable processing component carried by said rotatable drive member.
3. Apparatus as recited in claim 2 wherein said motor is a variable speed switched reluctance motor.
4. Apparatus as recited in claim 3 wherein said bearing means comprise magnetic bearings.
5. Paper pulp processing apparatus comprising a motor having a stationary member and a rotatable drive member, a rotatable pulp processing component carried by said rotatable drive member, and bearing means supporting said rotatable drive member and said rotatable pulp processing component.
6. Paper pulp processing apparatus as recited in claim 5 wherein said motor is a variable speed motor and wherein said bearing means comprise magnetic bearings.
7. Paper pulp processing apparatus as recited in Claim 6 wherein said stationary member is disposed along a longitudinal axis within said rotatable drive member, said rotatable pulp processing component being a screen cylinder.
8. Paper pulp processing apparatus comprising a variable speed motor having a stator and a rotor rotatably disposed along a longitudinal axis within said stator, a rotatable pulp processing component carried by said rotor, and magnetic bearings supporting said rotor and said rotatable pulp processing component.



9. A paper pulp processing apparatus as recited in Claim 8 further comprising a hollow rotor and hollow shafted rotatable pulp processing component for feeding paper pulp suspension through both said rotor and rotatable pulp processing component.
10. A paper pulp processing apparatus as recited in Claim 9 wherein said variable speed motor is a switched reluctance motor.
11. A paper pulp processing apparatus as recited in Claim 10 wherein said rotatable pulp processing component comprises a refiner disk and wherein said paper pulp apparatus is a disk refiner.
12. A paper pulp processing apparatus as recited in Claim 11 wherein said rotatable pulp processing component comprises a fluid foil and wherein said paper pulp apparatus is a screen cylinder.
13. A paper pulp processing apparatus as recited in Claim 10 wherein said rotatable pulp processing component is a rotatable screen cylinder.
14. A paper pulp apparatus as recited in Claim 8 wherein said rotor and said rotatable pulp processing component are integral.
15. A paper pulp apparatus as recited in Claim 8 wherein said magnetic bearings comprise a first set of magnetic bearings to control radial position of said rotor and said rotatable pulp processing component relative to said stator.
16. A paper pulp apparatus as recited in Claim 15 wherein said magnetic bearings comprise a second set of magnetic bearings to control axial position of said rotor and said rotatable pulp processing component along said longitudinal axis.

17. A paper pulp processing apparatus as recited in Claim 8 wherein a portion of said rotor comprises an inclined surface positioned adjacent an inclined surface of said stator, said magnetic bearings positioned along said inclined surfaces and controlling both axial and radial positioning of said rotor and said rotatable pulp processing component relative to said stator.

18. A disk refiner comprising a switched reluctance motor comprising a stator and a rotor rotatably disposed along a longitudinal axis within said stator, said rotor carrying a refiner plate, a second refiner plate positioned along said longitudinal axis and adjacent said first refiner plate, and magnetic bearings operatively associated with said stator and rotor for supporting said rotor.

19. A disk refiner as recited in Claim 18 wherein said first refiner plate comprises an opening therein and wherein said rotor comprises a hollow shaft communicating with said opening in said first refiner plate to define a fluid flow input for feeding a pulp suspension between said first and second refiner plates.

20. A disk refiner as recited in Claim 18 comprising an end plate adjacent said stator and rotor and having said second refiner plate mounted thereon, said disk refiner further comprising linear movement actuator means for selectively moving said second refiner plate along said longitudinal axis toward and away from said first refiner plate.

21. A disk refiner as recited in Claim 18 wherein said first refiner plate is attached to said rotor at a first end surface of said rotor, said first end surface of said rotor positioned within a first end of said stator along a first end surface of said stator, said first end surface of said rotor and said first end surface of said stator, together presenting a pair of inclined surfaces, and wherein said magnetic bearings are positioned along said inclined surfaces for controlling axial and radial positioning of said rotor within said stator.

22. A disk refiner comprising a switched reluctance motor comprising a stator and a rotor rotatably disposed along a longitudinal axis within said stator, said rotor having a first end carrying a first refiner plate and a second end carrying a second refiner plate, a first end plate spaced axially from said first refiner plate and a second end plate spaced axially from said second refiner plate with said first and second end plates and said stator defining an enclosed housing, a third refiner plate mounted on said first end plate and axially spaced from said first refiner plate, a fourth refiner plate mounted on said second end plate and axially spaced from said second refiner plate, and magnetic bearings operatively associated with said stator and rotor for levitatingly supporting said rotor with said stator.
23. A disk refiner as recited in Claim 22 wherein said first end plate, second refiner plate and first refiner plate comprise openings therein, said rotor comprising a hollow shaft in communication with said openings in said first and second refiner plates and said first end plate to define a fluid flow input for feeding a pulp suspension between said first and third refiner plates and between said second and fourth refiner plates.
24. A disk refiner as recited in Claim 22 further comprising a first linear actuator means for selectively moving said third refiner plate along said longitudinal axis toward and away from said first refiner plate and a second linear actuator means for selectively moving said fourth refiner plate along said longitudinal axis toward and away from said second refiner plate.
25. A disk refiner as recited in Claim 22 wherein said first end of said rotor borders said stator along a first inclined surface and wherein said second end of said rotor borders said stator along a second inclined surface and wherein said magnetic bearings are positioned along both said first and second inclined surfaces to control axial and radial positioning of said rotor within said stator.

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26. A screen for screening a flow of papermaker's stock comprising a switched reluctance motor having a stator and a rotor rotatably disposed along a longitudinal axis within said stator, a screen adjacent said stator and having an accepts surface and a fluid inlet surface, a housing surrounding said screen, a fluid foil carried by said rotor to induce a flow of papermaker's stock along said fluid inlet surface of said screen, a first collection channel communicating with said accepts side surface of said screen to collect fluid flowing through said screen, a second collection channel communicating with said fluid inlet surface of said screen to collect fluid that does not flow through said screen, and magnetic bearings operatively associated with said stator and rotor for levitatingly supporting said rotor.

27. A screen as recited in Claim 26 wherein said rotor comprises a hollow shaft defining a fluid inlet channel to feed said papermaker's stock to said fluid foil.

28. A screen as recited in Claim 27 wherein said fluid foil is integral with said rotor and wherein said fluid foil comprises apertures therein for forwarding said papermaker's stock from said inlet channel to said fluid inlet surface of said screen.

29. A screen as recited in Claim 27 wherein said magnetic bearings comprises radial magnetic bearings disposed about said rotor to control radial positioning of said rotor in said stator and said magnetic bearings also comprise axial magnetic bearings disposed along said rotor to control axial positioning of said rotor within said stator.

30. Method of processing a material wherein a rotatable processing component is brought into contact with said material, said method comprising, providing a motor having a stationary member and a submersible rotatable drive member, and combining said submersible rotatable drive member and said rotatable processing component into a submersible integral unit.

31. Method as recited in claim 30 further comprising providing submersible bearings along said submersible integral unit.

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32. Method as recited in claim 31 wherein said material is a fluid and further comprising, cooling said rotatable drive member by calculating said fluid in heat exchange contact with said rotatable drive member.

33. In a method of processing a pulp suspension wherein a rotatable pulp processing component is brought into contact with said pulp, the improvement comprising:

- 5 a.) providing a variable speed motor having a stationary member and a rotatable drive member,
- b.) combining said rotatable pulp processing component and said rotatable drive member into an integral unit; and
- 10 c.) providing bearings along said rotatable pulp processing component and said rotatable drive member to support said rotatable drive member within said stationary member.

34. Method is recited in Claim 33 wherein said bearings are magnetic bearings.

35. Method as recited in Claim 34 wherein said variable speed motor is a switched reluctance motor.

36. In a method of processing a pulp suspension wherein a rotatable pulp processing component is brought into contact with said pulp, the improvement comprising

- 5 a.) providing a variable speed motor having a stator and a rotor rotatably mounted along a longitudinal axis within said stator
- b.) combining said rotatable pulp processing component and said rotor along a common shaft; and
- c.) providing magnetic bearings along said common shaft and said stator to support both said rotatable pulp processing equipment and said rotor.

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37. Method as recited in Claim 36 wherein said variable speed motor is a switched reluctance motor.

38. Method is recited in Claim 37 wherein said shaft is hollow and including the further step of providing a fluid flow through said hollow shaft.

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International Bureau



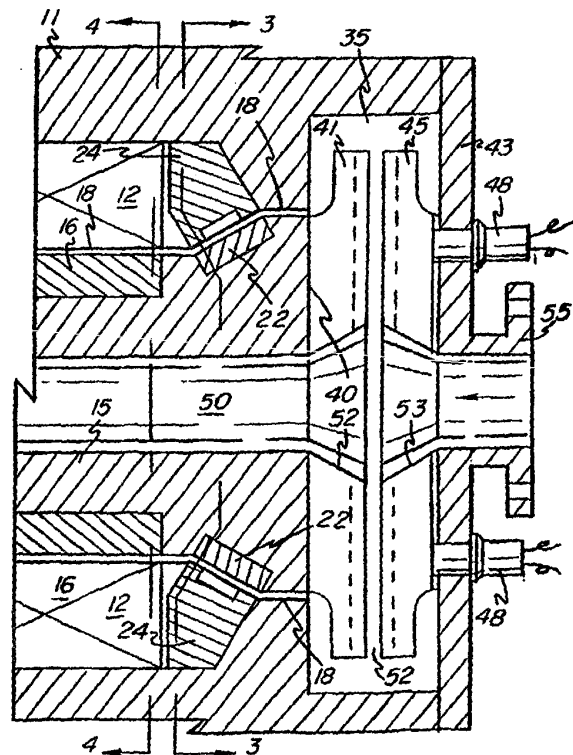
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : H02K 5/132, 7/09, 7/14, B01D 33/56, F04B 17/04, B02C 7/02, 7/06, 7/14, 7/16		A1	(11) International Publication Number: <b>WO 99/52197</b>
(21) International Application Number: PCT/US99/07729		(43) International Publication Date: 14 October 1999 (14.10.99)	
(22) International Filing Date: 8 April 1999 (08.04.99)		(81) Designated States: BR, CA, CN, JP, MX, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(30) Priority Data: 60/081.033 8 April 1998 (08.04.98) US		Published With international search report.	
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(74) Agents: PEACOCK, Bruce, E. et al.; Biebel & French, 35 East First Street, Dayton, OH 45402 (US).			

(54) Title: INTEGRATED PAPER PULP AND PROCESS MACHINERY HAVING INTEGRATED DRIVE AND CONTROL AND METHODS OF USE THEREOF

(57) Abstract

The invention pertains to equipment and methods in which the rotatable drive member of a variable speed motor, such as a switched reluctance motor, carries a rotatable pulp processing element (10). Magnetic bearings (22, 24) levitatingly support both the rotatable drive member (15) and associated rotatable pulp processing element (41) and control axial and radial positioning thereof relative to the axis of rotation of the drive member.



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DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/07729

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : Please See Extra Sheet.

US CL : 310/67R, 87, 90.5; 210/380.3 417/355, 423.7; 241/259.1

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 310/61, 67R, 87, 90.5; 210/258, 365, 380.3 417/355, 356, 423.7 241/259.1, 259.3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

U.S. APS, Derwent

Search terms: disk refiner, pulp, switched reluctance, screen

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 5,692,882 A (BOZEMAN, JR. ET AL.) 02 December 1997 (02/12/97), see entire document.	1-2, 30-32 ---- 3-4, 34, 37
X ---- Y	US 5,087,171 A (DOSCH ET AL.) 11 February 1992 (11/02/92), see entire document.	5, 33 ---- 6-17, 34-38
Y	US 3,932,069 A (GIARDINI ET AL.) 13 January 1976 (13/01/79), see entire document.	3-4, 10-13, 18 - 25, 35, 37
Y	US 5,385,581 A (BRAMM ET AL.) 31 January 1995 (31/01/95), see entire document.	18-25
Y	US 5,398,877 A (XIANGZHI) 21 March 1995 (21/03/95), see entire document.	18-25

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Z* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

14 JUNE 1999

Date of mailing of the international search report

01 JUL 1999

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US99/07729

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,246,108 A (CROOPNICK ET AL.) 20 January 1981 (20/01/81), see entire document.	1-38
Y	US 5,013,460 A (MEREDITH) 07 May 1991 (07/05/91), see entire document.	12-13
Y	US 5,288,215 A (CHANCELLOR ET AL.) 22 February 1994 (22/02/94), see entire document.	9, 19, 23, 38

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER:

IPC (6):

H02K 5/132, 7/09, 7/14; B01D 33/56; F04B 17/04; B02C 7/02, 7/06, 7/14, 7/16